The Newsletter of
Engineering Heritage Australia
The Institution of Engineers, Australia
No. 17 - November 2005

Something old and something new(er): Two dams honoured

On 22 April 2005, Hume and Dartmouth dams were recognised as National Engineering Landmarks at a ceremony arranged by the Murray-Darling Basin Commission (MDBC) at Hume. The Commission also provided an inspection of Dartmouth by bus. The National Deputy President Peter Cockbain spoke about the Plaquing Program and the heritage significance of the dams, before presenting the plaques to the President of the MDBC, the Rt Hon. Ian Sinclair AC.

National Deputy President, Peter Cockbain and the President of the MDBC, the Rt Hon Ian Sinclair AC

In 1915 the River Murray Waters Agreement was signed between the Commonwealth and New South Wales, Victoria, and South Australia, with the legislation also establishing the River Murray Commission (now the Murray-Darling Basin Commission) as the implementing authority.

Hume Dam is the largest of the Murray River works with the first sod being turned on 28th November 1919. The intended reservoir capacity was 2 million acre-feet (2467 gigalitres - GL), but financial problems of the Great Depression caused its temporary reduction to 1.25 million acre-feet (1542 GL). The reduced-scale works were opened by Governor-General Lord Gowrie on 21st November 1936.

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‘ … the most significant engineering development made on the Snowy Scheme’

Cooma’s Lambie Gorge is a site of cultural significance to the Ngarigo Aboriginal community. The local Reconciliation Group received an Environmental Trust grant in 2004 to develop a walking trail in the Gorge so its significance could be shared with the wider community.

The Gorge is also of historical and technological significance in the European settlement of Cooma and in the development of the Snowy Mountains Scheme. It was where Snowy engineers conducted experiments to develop rock-bolting technology from an empirical and temporary technique to a permanent one, founded in structural design and rock mechanics. This enabled the conversion of freshly exposed unstable rock faces of caverns and tunnels, into a structural mass that required no external support.

Rock bolting had been used for decades before the Snowy Mountains Hydro-electric Authority began detailed design analysis of the technique in July 1956. Germany, England, Sweden, USA, Brazil, South Africa, and Australia all had projects that used rock bolts to pin excavated rock faces to the sound mass behind. This was still the concept applied selectively in the Guthega lined headrace tunnel in 1953-4. The development of design formulae and ratios, plus the methodology to fix, tension, and reliably grout rock bolts with the advance of each excavation blast, revolutionised tunnelling for the benefit of the engineering construction industry world-wide.

The rock bolting site in Lambie Gorge, Cooma

Within two years of the new technique being proved (in 1959), nearly 40,000 rock bolts had been installed on the tunnel and underground cavern projects of the Snowy Mountains Scheme. Only in fault zones was it necessary to place external steel and concrete supports in places where lining was not mandatory. Bolt and anchor manufacturers, construction contractors, miners and drillers, embraced the development that was speeding up underground excavation and providing a safer underground mining environment, thus satisfying the inspectors of the Department of Labour and Industry. New engineering texts were written on the subject and catalogues of standard rock bolt products were produced.

In addition to laboratory testing, early field tests and in situ experimental work was done in Lambie Gorge adjacent to the Authority’s Scientific Services

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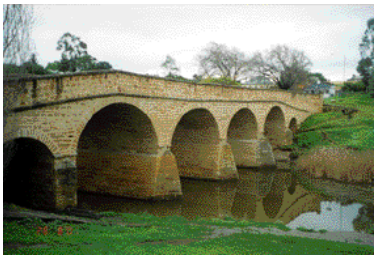
Richmond Bridge plaque well read



Richmond Bridge, Tasmania

Richmond, a delightful town near Hobart, is noted for its historic bridge and gaol, art galleries, restaurants and other attractions. Visitors stroll around its streets in numbers, particularly at weekends. Most people arriving at the oldest bridge in Australia (1825), stop to read the Historic Engineering Marker plaque. It is prominently located on an extension of a parapet wall in a paved pedestrian-friendly area clear of traffic. This plaque is one which promotes Engineers Australia on a regular basis.

Engineering Canberra: an oral history project

Engineering Canberra is a worthy topic for an oral history project. Indeed, the entire city in its surrounding landscape was engineered by a fledgling nation after federation in 1901. Choosing a perfect site for the nation's capital employed numerous people and took many years of examining localities whose environments would offer the right conditions to place the heart and soul of Australia's political life and house the people who would make it happen.

In 1908, after years of searching, the limestone plains near the established towns of Yass and Queanbeyan, New South Wales, graced with hills and valleys and the flow of the rivers of the Murrumbidgee and Molonglo, became that perfect site, and is today the city of Canberra (from the Aboriginal word Kamberra or Kamberry).

Upon settling in Canberra in 2003, I was invited by Gary Barker, Chair of the Canberra Panel of Engineering Heritage Australia to assist with their oral history work. As part of the nationwide oral history program run by the Institution of Engineers, the Canberra Panel had several eminent engineers on their waiting list to be interviewed. A few were already inducted into the Canberra Engineering Hall of Fame.

Gary Barker took little time in setting me the task to tackle those in waiting.

To date, I have completed five interviews with one in the pipeline. All of these interviews are for the national program and consist of 26 hours of interview time. Whilst these interviewees have Canberra engineering experience, and this was the focus of each interview, they have all contributed widely and significantly to the development of engineering theory and practice throughout Australia, and in all fields of engineering endeavours from civil and structural to mechanical and electrical and environmental engineering. Many have lengthy public service careers, some in the Commonwealth Department of Works, such as Charles Bubb and Ross McIntyre; some went on to be educators in their field after retiring from service, such as Norm Sneath, and others have international recognition for their work, such as Professor Brian O'Keeffe who changed the face of aviation and navigation on a global basis. These interviews provide an invaluable record of Australia's engineering history and will be archived in the State Library of NSW's oral history collection

Whilst it was agreed by the members of the Panel that these interviews were important for engineering history and demonstrating the legacy of the Australian engineer, the members realised that the Panel's history was also worth recording. Gary Barker, in particular, believed that it was time to record the story of Canberra's engineering group as it had at least a 25 year story to tell and a few of its founding members were still on the Panel. These recordings would not only in themselves reveal the history of the Panel, but they would also be used in the 3rd edition of *Canberra's Engineering Heritage*. The Panel is in the process of investigating an interactive format for the 3rd edition of this popular book, first published in 1983.

My task involved researching the Panel's history, from its days as a Heritage Sub-Committee of the Canberra Division of the Institution of Engineers, to its current status as a Panel. Fortunately, the members kept their records of meetings and other items of relevance to their development. I used these records as a framework for compiling a thematic questionnaire for interviewing three of the senior current members. All have long ties to the Group's early history and phases of evolution.

Byrne Kenny, Ross McIntyre and Lloyd Wrigley were willing subjects and while all related similar vignettes of the origins of the Group, meeting venues and intriguing glimpses into the people who were the trailblazers and the machinations of the Group, they all had their unique perspective and distinct fields of heritage interest and focus.

Their stories will form part of the overarching story of Canberra's engineering history and heritage and add a human voice to the solid infrastructure of engineering a young city. The interviews revealed more about the individual and their relationship to the group, and their collective concerns for understanding what is heritage and what should be preserved for the future. Their now consistent position on heritage evolved over the course of their 25 year history. Apart from the celebratory function of the Group and the activities commemorated and achieved, an important common thread throughout the three interviews worth noting is: the legacy story – that is, the constant concern of how to preserve their records, the oral history interviews, their collections of knowledge and learning, in a time of reduced funding and minimum repository space. As a result of this project, the Canberra Heritage Panel is actively searching for a home for their archives and will be incorporating these interviews into *Canberra's Engineering Heritage III.*

(Resources: Interviews for the Canberra Panel of Engineering Heritage Australia with Byrne Kenny, Ross McIntyre and Lloyd Wrigley, 2005 by Dr Margaret Park; Taylor, Ken and Headon, David, *Canberra: the Guide: A Fresh Perspective on Australia's Capital City,* Harper Collins, Sydney, 1997.)

Margaret Park

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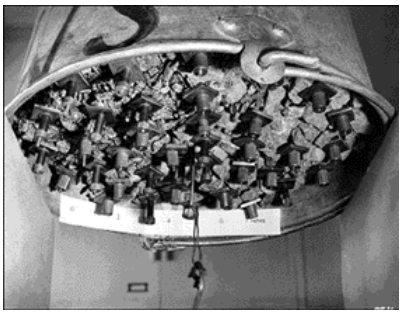
' … the most significant engineering development

testing laboratories in Cooma up until June 1962. The site is still accessible and shows the remnants of a succession of experiments, with a variety of bolt types.

At the test site there are 50 or so holes drilled into rock faces, where rock bolt pull-out tests were conducted. Some of the holes still contain rock bolts, some bolts are cut off and some are partly separated from the vertical rock face. There was a succession of vertical faces into which holes were drilled for the insertion of the bolts to be tested. When the surface of each face had been fully used the cliff was blasted back to expose a fresh face for another set of tests. This can be seen, and explains the broken rock in front of the test site, with some of the rocks showing drill holes.

'On the basis of these experiments and through field experience, the Snowy team developed an understanding of the way in which systematic rock bolting in a jointed rock mass forms a self-supporting compression zone within the rock mass' (Professor E T Brown FREng FTSE).



The bucket filled with crushed rock and model rock bolts used to demonstrate the principle to tunnel workmen

It has been estimated that rock bolting reduced the steel required for support to one eighth of that required using conventional methods. It also saved the cost of over-excavation to accommodate supports and / or lining. At the time, contractual pricing for fully concrete lined tunnels, where the rock face had light steel external supports, was 45% dearer than tunnels supported by rock bolts. Safety also improved with rock bolting, and tunnelling was faster as the bolts were installed immediately the new rock surface was exposed.

Rock bolting in tunnels and in caverns, for underground power stations and other purposes, saved many millions of dollars in construction of the Snowy Scheme.

The work carried out on the Snowy Mountains Hydro-electric Scheme advanced the then state-of-the-art in rock mechanics and rock engineering for large tunnels and underground excavations. High level expertise was developed from the low levels pre-existing in Australia in almost all areas of underground excavation engineering in rock, including site investigation and rock mass characterisation, design analysis using the photo-elastic method of stress analysis, the theory and practice of rock bolting and rock mass performance monitoring. This expertise led not only to the successful construction of the underground excavations of the Snowy Scheme but advanced the state-of-the-art internationally'.

'Indeed it has been suggested that the development and use of rock bolting for permanent support of underground excavations was probably the most significant engineering development made on the Snowy Scheme' (Professor E T Brown).

Former Snowy engineers, Messrs Walter B Mills and Ivars Freimanis of the Monaro Group of Engineers Australia have seized the opportunity to join with the Ngarigo descendants in their proposed Lambie Gorge walking trail, by incorporating interpretation of the rock bolting development site. They also propose to nominate the site as a National Engineering Landmark.

Walter B Mills and Michael Clarke

EHA is not alone!

This report features headline articles from some recent newsletters of organizations with similar objectives to Engineering Heritage Australia:

- The Panel for Historical Engineering Works (PHEW) of the Institution of Civil Engineers in the UK publishes a quarterly newsletter. The December edition (Number 104) featured the 2004 Historic Bridge and Infrastructure Awards. The awards celebrate excellence and innovation in conservation.
  Twenty two nominations were received and five Awards were made plus four Commendations and one Special Recognition. The five Awards were:
  · Restoration of Whorlton Suspension Bridge in County Durham
  · Refurbishment of Pontcysylite Aqueduct and Trevor Basin, Llangollen, Wales
  · Refurbishment of Waterloo Train Shed Roof, London
  · Strengthening and refurbishment of Hungerford Canal Bridge, West Berkshire
  · Refurbishment of Myton-on-Swale Bridge, North Yorkshire

- ***Links*** is the quarterly newsletter of the Newcomen Society. The society has a tradition of holding some of its regular meetings outside the UK. Links No 192 of December 2004 reports on the Spring Meeting held in Budapest, capital of Hungary just one week after Hungary joined the European Union. The group of 23 members from the UK spent four days looking at everything in and around Budapest of relevance to the Newcomen Society's "history of engineering and technology" mandate.
  The group visited seven museums; inspected the famous Chain Bridge across the Danube and rode on the Budapest Metro which includes the oldest metro line in Europe.

- The December 2004 newsletter of the Northern Mill Engine Society reported further progress towards opening of their museum at Bolton, 16km north of Manchester. The museum contains a substantial collection of restored and operational stationary steam engines housed in the old cotton storehouse of the Atlas Mills. The restoration of engines and building of the museum environment within the cavernous store building has taken decades but the museum is now close to opening. The last significant task is the building of a Boiler House and commissioning of a second-hand boiler already acquired by the society. Most of the engines have been recovered from mills and factories in Lancashire which was the world centre of the cotton industry during the 19th Century.

- The quarterly Bulletin of the International Stationary Steam Engine Society (ISSES) No. 26.1 contains three articles on Australian sites including a major article on the Steam Operations at the Sovereign Hill outdoor museum at Ballarat, Victoria. Written by Tim Sullivan, Anna Kyi and Harold Conder the article describes the four large steam engines which have been restored and which work every day at Sovereign Hill to demonstrate the way a 19th Century gold mine worked. ISSES has branches in the UK, USA and Australia with a membership of over 600 so its publications have a world-wide audience.
  Other articles in this particular Bulletin on Australian subjects covered the West Coast Pioneers' Museum at Zeehan in western Tasmania and the John Key Beam Engine at Mannum in South Australia. These articles were written by EHA members Owen Peake and Nigel Ridgway respectively.

Owen Peake

Awarding merit

Further awards have been made under the Award of Merit for Engineering Heritage program to recognise and show appreciation to members of Engineering Heritage Australia committees and groups, and their supporters and collaborators. The award recognizes significant voluntary service, often over many years, to the cause of engineering heritage.

An Award of Merit was presented to Leo Izod by the Administrator of the Northern Territory in Darwin on 5 October 2004.

Leo arrived in Darwin with his parents in 1946 at age 12. He completed his education in Darwin and afterwards worked in family businesses.

He joined the then Northern Territory Administration in 1961 and remained with the government until he retired in 1999. During his long career he was a Vehicle Inspector, Motor Mechanic on remote Aboriginal communities, Technical Instructor at Kormilda College in Darwin and a Technician with the History Section of the Northern Territory Museum.

During the last 50 years Leo has maintained an interest in the machinery used throughout the Northern Territory, collecting old pieces and restoring them to running order. Since 1976 he has built up a collection of petrol, diesel and steam engines dating back to the early 1900s. This collection was motivated by his concern for the amount of history of the Northern Territory which was lost during the cleanup after Cyclone Tracy in Darwin in 1974.

Since 1999, Leo's collection, which now numbers seventy four stationary engines and numerous other items, has been housed in the heritage-listed 1934 QANTAS hangar at Parap in Darwin.

Leo has given significant assistance to the Northern Division Engineering Heritage Subcommittee on a wide range of engineering heritage issues.

A further Award of Merit was presented to Keith Drewitt at the Fellows Lunch in Hobart on 18 October 2004 by National President Doug Jones.

In 1940 Keith Drewitt began a five year apprenticeship as an electrical mechanic. His apprenticeship was interrupted for 3 years by war service in the RAAF as an Instrument Technician. He joined the Hydro-Electric Commission of Tasmania as a Technical Officer in 1948 and, through study at night school, obtained an Engineering Diploma in 1954. On graduation he transferred to the Hydrographic Section, rising to Hydrographic Engineer in charge of the Section in 1974, the position he held until his retirement in 1984.

Keith became a member of the Tasmania Division Engineering Heritage Committee when it was formed in 1978, has been Chairman since 1988 and still is. He continues to be the face and the backbone of engineering heritage in Tasmania. He leads the small active group that devotes every Thursday to engineering heritage work. He is a strong supporter of the plaquing programme, having prepared at least five nominations and organized and chaired the award ceremonies.

He was the principal organizer of the Engineering Heritage Conference in Tasmania in 1992 and represented Tasmania on the National Committee on Engineering Heritage (now Engineering Heritage Australia) for 11 years from 1988.

Enquiries about the Award of Merit for Engineering Heritage can be made to the Administrator of Engineering Heritage Australia at (02) 6270 6525.

Owen Peake

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Something old and something new(er): Two dams honoured

The concrete spillway section was constructed by the Department of Public Works, NSW and the earth embankments (on the Victorian side) by the State Rivers and Water Supply Commission, Victoria.

The main dam was over 40 metres high and 1615 metres in length. It consisted of a substantial concrete gravity spillway and outlets section 308 metres long, a short embankment 131 metres long to the north and a larger embankment 1167 metres long to the south. At the time of its completion Hume was the second largest dam in the world.

Work re-commenced in 1950 to achieve the design capacity of 2467 GL. However, advent of the Snowy Mountains Hydro-Electric Scheme created the need to re-regulate an additional 550 GL diverted annually into the Murray system; this resulted in Hume Dam being further enlarged to 2.5 million acre-feet (3038 GL).

The work was completed in 1967 and included installation of 29 spillway gates, raising the crest 1.2 metres, vertical pre-stressed anchoring and additional drainage. Associated works were a concrete parapet wall along the earthen embankments as wave protection, a small earthen 'saddle' embankment at Bonegilla, raising of Bethanga Bridge, relocation of the township of Tallangatta, and a hydro-electric power station on the right abutment with two turbines generating a total of 50 MW (completed in 1957).

Over the years, remedial works have been carried out on Hume as part of continuing management to meet contemporary structural safety standards. These have included additional vertical tensioning of the spillway section to provide resistance to uplift pressures and seismic loads, and replacement of the original Larner-Johnson balanced needle irrigation valves with 2.74 m Boving fixed cone dispersion valves. A further works program, started in 1993 and completed in about 2004, involved a major rebuild of the embankments, penstock closure gates, and mechanical and electrical controls of the spillway gates.

Dartmouth Dam was constructed on the Mitta Mitta River (upstream of Hume in north eastern Victoria) to provide increased security against prolonged drought. It was designed by the Snowy Mountains Engineering Corporation and built by Thiess contractors under the supervision of the State Rivers and Water Supply Commission, Victoria.

Dartmouth is the highest dam in Australia at 180 metres and has a storage capacity of 4000 GL. Construction began in 1972 and was completed in 1979; it cost a total of $139 million.

The embankment is of earth and rock fill and comprises a central clay core, upstream and downstream rockfill zones and an extensive internal sand and rock filter system. The rock quarry on the left of the river gorge now forms the spillway.

The Dam has two tunnels for releasing water into the river. The High Level tunnel in the left abutment connects to both a 180MW power station and to an irrigation outlet at the toe of the dam.

The power station was significantly damaged in May 1990, when steel beams dislodged by surging in the dam's high level outlet works entered the turbine's spiral casing. This required a complete rebuild of the major generating works and the implementation of additional control and protection measures.

The Low Level tunnel (originally the diversion tunnel) is in the right abutment and is used when the high level outlet cannot be operated, due to either low operational water levels or maintenance. A downstream regulating pond (Lake Banimboola) allows fluctuations in flows from the dam to be released to the river at a nominated steady rate.

River Murray Works

In 2001, as part of its *Centenary of Federation Plaquing Program*, Engineering Heritage Australia awarded National Engineering Landmark status to the 'Engineering Works of the River Murray' as a whole. Plaques recognising this award are on display at Hume Dam, Yarrawonga Weir, and Weir & Lock 1 at Blanchetown. Also in 2001 the Goolwa Barrages at the river's mouth were plaqued as a National Engineering Landmark in their own right.

Michael Clarke

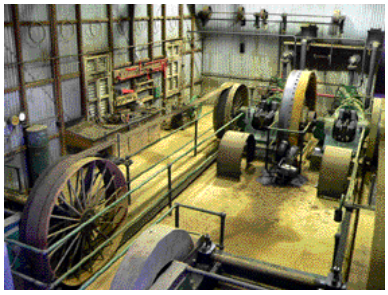
Comparing the view

The first of a regular column by EHA Chair, Keith Baker

I instinctively have my eye out for heritage places while travelling, and my patient wife of 37 years has become more observant of engineering structures and services over the years. While travelling over a long-weekend in central New South Wales I photographed some interesting engineering heritage, including Lucknow mining relics, Orange water supply and windmills at Gilgandra. When I showed some of these pictures during a break at our EHA Board meeting, it was suggested I should write a regular column for EHA news to share the knowledge of some of these places more widely.

Rather than embark on a simple travelogue it may be useful to make some comparisons with places we have plaqued, and others that may be worthy of the honour, since comparative analysis is part of establishing heritage significance.

So for my first column of Comparing the View, I will cover pumping stations for municipal water supply and the others in due course. The Lake Canobolas Pumping Station is housed in an unassuming galvanized iron shed below the spillway of Lake Canobolas north of Orange, but it houses an impressive Hornsby-Stockport two cylinder gas engine, fed by a coke gas generator, and driving two horizontal reciprocating pumps which supplied town water to Orange from 1918 to 1957. The equipment manufactured in 1915 appears to be original and complete. The installation and its housing were conserved by students at the Orange TAFE as a bicentennial project in 1988. This included construction of an elevated viewing platform the length of the pumphouse which allows visitors to inspect the machinery from a safe distance while avoiding the vandalism and pilfering which often deters such places being left open unattended.

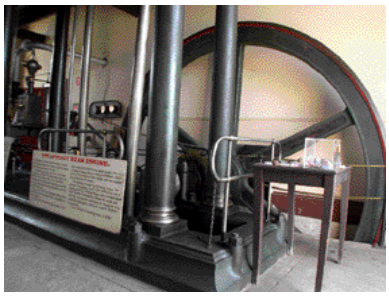


Lake Canobolas pumping station gas engine and pumps

Lake Canobolas Pumping Station has not been plaqued by EHA, but my mind was immediately drawn to two others that I have inspected before and during plaquing. Goulburn in NSW is supplied from the Marsden Weir Pumping Station which houses a beam engine with a directly connected piston pump in the well below and a pair of boilers manufactured by Appleby Brothers in 1883. In its 1886 colonial brick pumphouse, it has the distinction of being the only beam engine still workable in its original location in Australia. The installation was plaqued as a Historic Engineering Marker at the instigation of Sydney Division in 2003. The pumping station also houses a horizontal steam engine and electric driven pumps, and is frequently open for inspection when local enthusiasts have it running under steam.

Cotter Pumping Station

Another municipal water supply in the district is the Cotter Pumping Station which was plaqued as a HEM at the instigation of Canberra Division in 2000. It is an all electric installation, with the original two Gwynne turbine pumps manufactured in 1912, and others progressively installed in the same building from the 1930s to 1963 as Canberra's demand for water grew. It also has a piston pump driven by a water turbine in the adjoining building.



Marsden Weir Pumping Station Beam Engine

Between them these three installations cover a range of pumping technology spanning 80 years of manufacture and a significant part of the pumping and motive technology employed since the industrial revolution. I consider Lake Canobolas Pumping Station would be a worthy addition to the engineering heritage recognized by EHA (In his role as chair of the EHA plaquing committee, the Editor would be more than happy for someone to prepare a plaquing proposal!).

Keith Baker

A rare working model telephone exchange

Leon Gregg and Geoff Battersby with the restored model exchange

"As far as we can determine this is the world's only working model of a Siemens 16 automatic telephone exchange". This is the claim of Leon Gregg of Brisbane's Telstra Museum as he pats the 82 year old model exchange. "We have made lots of enquiries overseas and haven't located another". Leon and Geoff Battersby are retired Telstra engineers who have put several years of Wednesdays into restoring the model exchange to working condition.

The model exchange was initially used for the training of installation staff of Queensland's first automatic exchange at the PMG (now Telstra) exchange in South Brisbane, which was placed in service on 11th July 1925. The model was then used for training of PMG technical staff at the Central Technical College and later in the PMG's own training system. Up to the end of World War 2 it was a centrepiece of PMG displays at the Brisbane Exhibition where it stimulated publicity and recruitment. The PMG used Siemens 16 equipment in all automatic exchanges in Brisbane with the last equipment removed in the early 1980's.

The unit was in a state of extreme disrepair due to old age, mechanical damage and the effect of Brisbane's 1974 flood until it's restoration was undertaken by Engineers Gregg and Battersby. In restoring the model the engineers had only their own personal notes and memories to guide them.

On the 14th July 2005 the restored model was again a centerpiece, this time for a paper on Automatic Telephony at Engineers Australia's Hawken Auditorium in Brisbane. The model was transported, with extreme care, in its three original boxes and has enough equipment on it to illustrate dial tone generation, switching within a four subscriber exchange and connection to manual exchanges. The paper covered both manual and automatic exchanges, their history, and their technology. Gregg and Battersby finished with a hands on demonstration of the equipment with much audience participation.

Now that the model is fully restored to working order it will be displayed in the Telstra Museum in Queensland. The Museum is operated by expert volunteers of the Queensland Post & Telecommunications Society. Their collection includes a multitude of items from the past 150 years of communications, many of them in full working order. The Museum occupies buildings behind the Albion Telephone Exchange at 3 Oriel Road (cnr Sandgate Rd), Clayfield. It is open each Wednesday from 9am to 3pm. Admission is free to all, but groups need to book on (07) 3862 2958.

Leo Moloney

HEM plaque unveiled at Adelaide River Railway Bridge, NT

Chief Minister Clare Martin about to unveil the plaque. Northern Division President, Dave McHugh looks on

A Historic Engineering Marker was unveiled at the 1888 Adelaide River Railway Bridge on 3 December 2004 by Clare Martin, Chief Minister of the Northern Territory.

The date was significant as it was the 116th anniversary of the opening ceremony for what was then called the Palmerston and Pine Creek Railway on 3rd December 1888. Palmerston was later renamed Darwin and the railway was later called the North Australia Railway and was extended in several stages to Birdum about 400 km south of Darwin but closed in 1976.

The old bridge is not in use today. It stands beside three other bridges over the Adelaide River in the centre of the little community of Adelaide River, 112 km south of Darwin. Looking downstream there is the concrete bridge of the new standard gauge FreightLink railway in use since January 2004, the Edwin Verburg Bridge which carries the Stuart Highway, built in 1980, and the old "low level" road bridge.

The old railway bridge was designed by the South Australian Railways and the drawings were signed by Engineer-in-Chief H C Mais in 1885. It was built by James Martin of Gawler in South Australia, who was a sub-contractor to the main railway construction contractors, Charles & Edwin Miller. It was completed in late 1888.

The bridge has five spans of 100 feet (30 metres) each, of "half-through" lattice girder construction, supported on four sets of twin cylindrical cast iron caissons in the riverbed and on concrete abutments at each end. The original construction material was wrought iron, although crude rolled steel section reinforcement was added as late as the 1960s. The bridge is in good condition apart from the timber work of the transoms, sleepers and decking, which has been destroyed by bush fires since the bridge was last used as a "high level" road bridge in 1980.

The ceremony was attended by nearly 100 people including the 42 students and staff of the Adelaide River Primary School. After the brief ceremony held adjacent to a concrete plinth on which the plaque is mounted 20 metres south of the bridge, the guests retired to the historic Adelaide River Railway Station a few hundred metres further south for morning tea.

We imagine that the opening of the Palmerston & Pine Creek Railway was a big event in the Northern Territory. The opening of the new railway early in 2004 was another big event for the Northern Territory. As we drank our morning tea a southbound freight train rolled slowly through the old railway station, having been warned that a crowd had gathered in Adelaide River – passing trains have been a part of this town for a long time.

Owen Peake

Barwon sewer aqueduct, Geelong

The early history of the structural use of reinforced concrete (1890s-1930) has by now developed into a heritage issue: a number of structures designed and built in those days were highly imaginative and were witness to optimism and excitement. These were generated by the use of a new building material which had the promise of liberating our built environment, replacing timber flooring with a non-combustible, composite material, strong in both tension and compression, which could be formed on the building site into any desired structural or ornamental shape. This process is still in train, especially considering the development of prestressed and partially prestressed concrete. As a result, we have inherited a number of outstanding early structures, which enable us to trace the development of the use of this material. One of the foremost of these is the Barwon sewer aqueduct in Geelong.

Part of the aqueduct

This aqueduct was built in 1913-1916, as a link in the outfall sewer of the City of Geelong to Black Rock on the south coast of Victoria. It straddles the Barwon River flood plain at Breakwater, just South of Geelong, and has a total length of 750 m in 14 spans. It is by far the longest, and largest, structure still in existence built according to the structural theory developed by Armand Considère in early 1900. Designed and built by the firm of Stone & Siddeley, it was commissioned in 1916, and decommissioned in 1992. It was entered in the Historic Buildings Register in 1981 (later the Victorian Heritage Register, 1995), and is thus protected under the Victorian Heritage Act, 1995. It is also listed in the Register of the National Estate.

Detail of the Barwon River Aqueduct, Geelong

The structure suffers from considerable degradation, due to corrosion of reinforcing steel caused by carbonation of the concrete cover. Consequently, an extensive rehabilitation program is required. First steps towards implementing this have been taken by Heritage Victoria. More research and trials are needed. Focus of this work at present is investigation of existing electro-chemical realkalisation methods. However, first trials have proved inconclusive and more work needs to be done. A preliminary estimate of the restoration is of the order of $500,000 per year for some eight years. This is based on working with relatively small, well-trained and supervised crews. A number of the smaller-sizes web members would have to be replaced completely.

At this stage there are still both technical and financial problems associated with the restoration.

J.L. van der Molen

A Peake at Steam

(The editor apologizes for the outrageous homophony of this piece in a continuing series.)

Peak Gold Mine, Cobar

The engine at Peak Mine, Cobar

Cobar is a country town 500 km west of Sydney and the Peak Gold Mine is located 8 km south of the town. Mining for copper in the vicinity of Cobar commenced in 1871. Gold was discovered at the Peak by Henry Cornish in 1870. A stamping battery was commissioned in 1896. The mine operated spasmodically over the decades and the ownership changed hands many times.

Gold production increased in the period 1982 to 1995 under the ownership of CRA (Conzinc Rio Tinto), now Rio Tinto. During this period gold production was 428,480 ounces compared to a total of around 20,000 ounces from 1880 to 1953. When CRA started operations it was a condition of their lease that the machinery from the old mine was not destroyed and they erected a fence around the machinery which consists of a Cornish boiler, single cylinder horizontal steam engine and 10 head stamping battery manufactured by T Hodgkinson & Company Engineering Works, Newtown, Sydney.

The engine was manufactured at the Atlas Works of Davy & Company, Sydney in 1874 so it was second-hand when installed at Peak. This is an early construction date for any Australian made engine. It has a bore of 17 inches (432 mm) and stroke of 36 inches (914 mm). The engine of 22 nominal horsepower is mounted on a timber bed, which in turn rests on an elaborate brick plinth with a separate plinth for the outboard crankshaft bearing block. The 3.7 m diameter flywheel has eight round wrought iron spokes cast into a cast iron hub and rim. The flywheel is fitted with a crude manually operated band brake, the function of which is unclear.

Basic stamping batteries of this type were common in the Australian gold industry in the 19th century. In the earlier days they were typically driven by steam engines, later by internal combustion engines.

Peak Gold Mines now operate in the area winning nearly one million tonnes of ore per year from several prospects including Peak. The company is owned by Wheaton Minerals Asia Pacific Ltd. The parent company is Canada's fifth largest gold producer with offshore operations in Mexico, Brazil and Argentina as well as Australia.

Thanks are given to James Walker and Jennifer Walker of the Turon Technology Museum, Sofala, NSW whose research material was used in the preparation of this article.

Owen Peake

State heritage listing for tramway tunnel

A tunnel, which formed part of a private tramway system, has been entered recently in the Queensland Heritage Register, following a nomination from EHA (Queensland). Known as Laheys' Canungra Tramway Tunnel, this was a vital link in the extensive tramway system that from 1903 through until the 1930s delivered logs from timber leases in the Coomera valley in southeast Queensland to Laheys' sawmill in Canungra. The tunnel provided a route through the Darlington Range which lay between the valley and Canungra.

The official citation states that the tunnel is important in demonstrating the pattern of Queensland history as an example of a privately built, owned and operated tramway and as a feature of early timber getting and milling in Queensland. It demonstrated the high degree of creative and technical achievement required to solve complex engineering problems in the construction of Queensland's early railways in challenging environments and through the use of new and untried technologies.

Laheys' Tramway Tunnel as a tourist destination

The Lahey brothers milling operation in Canungra had expanded from its inception in 1884 to the stage where bullock teams could no longer handle economically the transport of logs to the mill. An experiment with a steam traction engine was not successful. Laheys decided to meet the challenge by building a tramway system, necessarily steeply graded, using the Queensland standard gauge of 3ft 6 in.

A detailed survey of the route was completed in 1900 and provided for a tunnel under the Darlington Range to meet grade and alignment requirements, although the grade against loaded trains remained at 1 in 16+ with an even steeper grade downhill to the mill that required installation of a safety switch. The total length of track was eventually 26+ km.

The tunnel as constructed is 91 m long with an approach cutting at each end. The tunnel is straight and rectangular in section, was cut through solid sandstone and is unlined. It shows very little sign of deterioration.

The tramway system is described in some detail in a paper by Robert K Morgan, revised by Frank Stamford, "Laheys' Canungra Tramway" published in 2000 by the Light Railway Research Society of Australia, Inc. This paper, inter alia, describes the one Climax and three Shay geared locomotives used on the tramway. These were designed to cope with the steep grades and sharp curves.

It is recorded that, in the year 1915 alone, 15000 tons of logs were delivered to the mill.

The tunnel was used during the Second World War for the storage of ammunition for the nearby Canungra Jungle Training Centre (now Kokoda Barracks). As a Centenary of Federation project it was cleaned out by volunteers from local organisations and made readily accessible along a walking track from a car park adjacent to the Beaudesert-Nerang Road.

A walk from the car park down to and through the full length of the tunnel presents no particular problems, although a torch can be useful in the darker portion.

The tunnel is the only physically-intact remaining feature of the tramway, but it is possible to follow the formation of the line away from each portal. The history of the tramway is described on information panels at the north-western portal.

Norm Traves

Sustaining Heritage: The Second International Engineering Heritage Conference

Delegates eating their boxed lunches while awaiting the ferry to Cockatoo Island. Note Pyrmont Bridge (NEL) and the Manly ferry, SS South Steyne, in the background.

Over 120 heritage professionals and devotees attended the Second International Engineering Heritage Conference held in Sydney at the Powerhouse Museum from 21 to 23 September. There were also more than 60 at the NSW Railways History Seminar held on the second day to celebrate the Sesquicentenary of the NSW railways.

The conference theme of *Sustaining Heritage* was chosen to emphasise that a sustainable and professional approach - including from volunteer organisations - is required to ensure the long-term conservation of heritage.

The conference built on the experiences of those who have successful track-records in conserving heritage works and artefacts and those who have developed strong volunteer organisations. Apart from exploring sustainability, engineers, architects, archaeologists, museum curators, leaders of volunteer organisations plus many others, discussed issues with which the heritage community is grappling world-wide. The retention of trade and professional skills and the need to increase the numbers of those involved in the evaluation and conservation of heritage works and artefacts, received constant mention.

One of the highlights was a paper from the Sydney Harbour Federation Trust describing the work and public consultation involved in conserving and returning former defence lands to the community, including colonial defence works; it was followed by an illustrative excursion to Cockatoo Island, the Trust's most complex and challenging site. To supplement the paper and the excursion, the Trust provided delegates with notes and a copy of its recent book *The Story of Cockatoo Island*.

Overseas speakers who gave perspectives on their heritage management procedures and local issues were Emeritus Professor Emory Kemp from the Institute for the History of Technology and Industrial Archaeology at West Virginia University, David Greenfield of the UK Panel for Historic Engineering works and Paul Mahoney, National Coordinator for the Historic Heritage Program of the Department of Conservation, New Zealand. Kristal Buckley, the President of Australia ICOMOS presented an Australian perspective.

To encourage interest in engineering heritage, the Sydney Engineering Heritage Committee ran a competition for young engineers and students with the prize being free registration worth $500. Andrew Pratley of the University of NSW was the winner; he attended all three days and found the conference valuable and interesting.

The venue for the Welcome Reception was the 1855 Sydney Mint, recently adapted as the headquarters of the NSW Historic Houses Trust. The reception included a fascinating tour that displayed the original fabric of The Mint, including its cast iron beams and girders modelled on the 1851 Crystal Palace in London.

At the conference dinner held at the *Watersedge* on the harbour foreshore at Walsh Bay, Peter Cockbain, Deputy President of Engineers Australia announced Professor Emeritus Ray Whitmore of Brisbane as the 2005 winner of the John Monash Medal for Engineering Heritage. Peter also made presentations to the winners of the Colin Crisp Award for Engineering Heritage Excellence. A Highly Commended award went to Richard Fooks for his restoration of an 1897 stiff leg derrick crane at Kyneton in Victoria. The award itself was presented to the West Coast Wilderness Railway in Tasmania, for the restoration - which included rolling stock, stations, 40 bridges and 33 km of track through rugged terrain - of the 1896 railway between Queenstown to Strahan.

Two tours preceded the conference. The three day Pre Conference Tour visited the Australian Nuclear Science and Technology Organisation's technology centre at Lucas Heights, the Sydney Tramway Museum and the 1844 Wollongong Harbour, with the first overnight stay being at the Nan Tien Buddhist Temple at Berkeley. The second day involved inspections of Port Kembla Harbour, the Historical Aircraft Restoration Society's facility and airfield at Albion Park Rail and the 1886 Goulburn Waterworks, to see in operation its original Appleby Bros steam-operated pumping engine. The overnight stay was at Bowral where after dinner Leonie Knapman gave a talk on the1878 Joadja Creek shale oil works. On the final day the tour visited the NSW Rail Transport Museum at Thirlmere and Warragamba Dam, where the inspection included the recently completed upgrading works including the new emergency spillway.

The Sydney Local Tour comprised an inspection of the North Head underground sewage treatment works with an alternative inspection of North Fort and the Australian Artillery Museum; a tour of the Middle Head and Georges Heights colonial fortifications dating from the 1870s; and an inspection of the Garden Island Naval Dockyard and Captain Cook Dock, including the large underground dock de-watering pumping station.

On display in the conference foyer were numerous stands by heritage organisations illustrating their work and offering free brochures as well as publications for sale.

After the conference there was a cruise to inspect the foreshore industrial sites of Sydney Harbour west of the Bridge, and a tour of the Tank Stream. Delegates also had the opportunity to inspect the *150 Years of Rail* exhibition at Central Railway Station and to take heritage train tours.

Many favourable and congratulatory comments have been received by the organisers that variously described the papers as being of high quality and the conference generally as excellent, valuable, thought provoking, a wake-up call, enjoyable and a great opportunity to make friends and to develop networks.

The Sydney Engineering Heritage Committee extends its sincere thanks to all the speakers, tour guides, the conference and seminar sponsors and supporters – Delta Energy, Hughes Trueman, Sydney Harbour Federation Trust, Sydney Harbour Foreshore Authority, Dr Don Fraser, Ampcontrol, Country Energy, Energy Australia and the National Standards Laboratory - and to the conference organiser, The Meetings Manager.

A CD containing the conference and seminar papers, speakers' biographies, some presentations and the tour notes, will be provided to all conference delegates. Copies of the CD can be purchased at $20 from Glenn Rigden rigden@accsoft.com.au .

Michael Clarke

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